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THE  
AGRICULTURAL LEDGER.

1911—No. 3.

GLYCINE HISPIDA.

SOY BEAN.

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THE SOY BEAN IN INDIA.

By DAVID HOOPER.

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The original home of the Soy bean plant (*Glycine hispida*, Maxim., **G. Soja**, Sieb. and Zucc.) is the extreme east of Asia, and it has been long cultivated all over the east between Japan and Java. According to Aiton it was introduced into England in 1790, and according to Professor Church it has met with some successful cultivation in Europe since 1873. Notwithstanding its recommendations the Soy bean has never been cultivated to any considerable extent in England and the continent of Europe. The plant was introduced into the United States of America in 1854 and was grown to a small extent in the Southern States, but from the year 1885 its cultivation as a forage crop has gained in importance in all the agricultural centres. Within the last two or three years a great deal of interest has been taken in the cultivation of Soy, and experiments are in progress in Government Farms in Cape Colony, Natal, East Africa, Gambia, Mauritius and Australia.

INTRODUC-  
TION.

It is difficult to ascertain the date of the introduction of Soy beans into India. There is no doubt that certain hill tribes, mostly of Mongolian origin, have cultivated the bean for a long time. At the Punjab Exhibition held at Lahore in 1864 Soy beans identified by Dr. Cleghorn, were sent from the Hill States. This is the first record of the beans being exhibited in this country, and shows that the cultivation was on an insignificant scale.

*Experiments in India.***EXPERIMENTAL CULTIVATION IN INDIA.****Madras,**

In 1882 Messrs. Jardine, Matheson & Co. of Hong-Kong sent a sample of Soy beans for experimental cultivation in the Saidapet Experimental Farm, Madras. The plants raised from these seeds were healthy but the yield of the crop was small.

In 1897 Surgeon-Colonel W. G. King, Sanitary Commissioner, Madras, strongly advocated the cultivation of Soy bean as a valuable food worthy of the attention of the people. In two experiments carried on at Saidapet during 1897-98, the yield of seed per acre was 468 to 495 lbs., respectively. Recent enquiries in Madras resulted in the opinion that the cultivation in the Presidency is still in an experimental stage.

**United Provinces.**

In 1882 some Japanese Soy beans were sent by the Government of India for trial to Saharanpur. In 1885 very good results were obtained, the black seeded variety giving a yield of 1,124 lbs. per acre, and the white seeded variety giving a yield of 561 lbs. per acre. In 1886 the acclimatised seed was widely distributed; in some cases the crop failed and in others it was fairly successful, but as a rule where seed was harvested it was said that the pulse was not popular in any form. The Botanical Gardens grew the crop for a few years longer but as there was no demand for the seeds the cultivation was abandoned. An interest in Soy bean, however, seems to have revived for the Agricultural Department has this year sent to the Reporter on Economic Products samples of the black variety of Soy beans from forty villages of the United Provinces.

**Central Provinces.**

At the Experimental Farm at Nagpur, Central Provinces, the bean was grown experimentally from Japanese seed first planted in 1885. The yield at the end of the first year was at the rate of 180 lbs. per acre, but taking the average of five years the result was 88 lbs. per acre. In the Report for 1908-09 it is stated that Soy beans were grown on a small area under field conditions and the yield was fair, but there was little local demand for the seed. It was, however, ground and formed an excellent addition to the diet of the farm cattle. Last year only 43 lbs. were obtained on light soil on the Nagpur Farm, the crop being practically a complete failure; on heavier soil 380 lbs. of seed were raised.

**Bombay.**

Soy beans have been grown at Poona for nine or ten years with varying results, and they have also been tried at Nadiad in Gujrat and elsewhere in the Bombay Presidency. In the Experimental Farm Report for 1901 a large yield was chronicled, but next year the crops at Poona and Surat failed. In 1904 a yield of 300 lbs. per acre was obtained in light land. One year later nineteen plots were under trial

but with unpromising results, for only five yielded seed enough to repay the cost of cultivation. The yield varied from 50 to 293 lbs. per acre, and it was found that only when the yield exceeded 200 lbs. was the crop profitable. In 1905-06 the Manjri Farm, Poona, grew nineteen plots with better results, probably due to better soil. The yield of some of the plots was on an average of 680 lbs. per acre—a highly remunerative return. A year later it was reported by Mr. Fletcher, Deputy Director of Agriculture, that an experiment made on the edge of black cotton soil gave a yield of 1,166 lbs. per acre, while adjacent plots gave from 395 to 650 lbs. per acre.

EXPERI-  
MENTAL  
CULTIVA-  
TION IN  
INDIA.

In the Agri.-Horticultural Gardens at Lahore Soy bean planted on a small area in 1894 yielded an estimated crop of 349 lbs. of seed per acre and 349 lbs. of fodder. Evidently it varies greatly in suitability to different soils and climates and does not seem to be adapted to the sea level plains of India. Panjab.

Gollan observed that the Japanese plant is erect, attaining a height of 12 to 15 inches, while the Himalayan form is a trailing plant. So far this vigorous growing plant does not appear in India to have been attacked by any insect or parasitic fungus.

With regard to Burma Mr. Burkill remarks: "The Burmese grow it under the names of Pe-nga-pi and Pe-kyat-pyin, sowing it never in great quantities along with other beans on the mud banks as the falling rivers leave them bare in October, or more sparingly still away from the rivers. The Kachins and other hill tribes grow a little of it on their hill clearings, the Kachins call it Lasi. The Khāsis, the Nāgās and other tribes between the Brahmaputra and Upper Assam cultivate it similarly.....In the Brahmaputra Valley it is grown as far as known only towards Bārpeta in the Kāmrup District." NAMES.

Soy beans are called "Bhut" in the Punjab, "Bhat", "Bhatwas" or "Bhatmas" in the United Provinces and in the hills as far as Darjeeling, and "Rymbai ktung" in Shillong and the Khāsi Hills. Mr. B. C. Basu gives the Assamese name for *Glycine* as "Patani jokra" and the corresponding Bengali name as "Chhai." In the Nāgā Hills it is called "Tsudza" or "Sudza." It is grown by the Lepchās in Sikkim and is called by them "Salyang" or "Silliangdun." "Pe-nga-pi" is the usual name for Soy bean in Burma, but it has been received under the name of "Lasi shapre tum" from Bhamo, and as "Lasi N'Loi" and "Lasi N'Hti" from Myitkyinā. The Santālī name appears to be "Disom Horee."

*Cultivation.***METHOD OF  
CULTIVA-  
TION.**

Soy bean is generally grown by itself as a kharif (rainy season) crop. The seed is sown in June or July and the crop is ripe in September or October, or three months afterwards. The seeds should be placed at a depth not exceeding 1 to 1½ inch. Eighteen plants to the square yard may be left after weeding. The plant prefers a peaty soil or one rich in organic matter; a calcareous soil is also favourable to its growth. Potassium sulphate or chloride is a good manure. Under ordinary circumstances it is not necessary to use any nitrogenous fertiliser as sufficient of this element is usually present in the soil, and like other legumes, this plant assimilates the free nitrogen of the air.

When grown for seed it has been found that half to three-quarters of a bushel, or 15 to 20 lbs., per acre is ample. When sown broadcast or drilled in rows very little cultivation is required. A slight harrowing when the plants are young is all that is necessary. If the drills have not been made too far apart it will be found that the plants will soon shade the soil sufficiently to keep the weeds in check and the surface in good condition. It is well known that the cultivation of leguminous crops enriches a soil in its available nitrogen content; certain nitrifying bacteria attack its roots forming tubercles, and these are capable of transforming the nitrogen of the atmosphere into nitrogenous compounds fit for absorption by plants.

When the Soy bean was first introduced into the United States it did not form root tubercles owing to the absence of the particular kind of bacteria in the soil, and in some places the tubercles were not developed though cultivated for a number of years. In other soils which evidently contained the necessary bacteria, the tubercles were developed from the beginning. A soil not containing the bacteria should be inoculated, that is to say some bacteria must be introduced.

**Green  
manure.**

The value of a crop used as a green manure depends on two things: first, the addition of nitrogen to the soil, and second the condition in which it leaves the soil after cultivation. It has been found in the United States that although Soy bean compares very favourably with other leguminous plants as the cowpea and clover as regards the first point, it does not leave the soil in as good a condition as the clover. It has been recommended that when a crop of Soy bean is turned under for green manure it must be well limed. This will obviate the bad effects sometimes experienced when a very heavy crop of legumes is ploughed under,

The Soy bean is largely employed in Japan as a soil renewer and is cultivated in rotation with cereal crops. An economical method of growing Soy bean, adopted in Japan, is to sow it between rows of maize. Two crops are thus obtained at once, besides which the soil is enriched by the increase of nitrogen. This method could no doubt be extended in India and used with some prospect of success in the cotton districts of Bombay and in the tea gardens of Assam.

METHOD OF  
CULTIVA-  
TION.

The time for harvesting the Soy bean crop necessarily depends upon the use for which the crop is intended. Under ordinary conditions the earlier varieties will mature in 75 to 90 days from the time of planting. It is desirable, however, in harvesting the crop for seed to cut before the pods are quite ripe, if they become too ripe, they will burst open in drying and a portion of the seed may be lost. If the green portion of the plant is to be used for feeding purposes it is a good practice to cut when the pods are half mature, as in that case the hay will contain a larger amount of digestible nutriment and will be much more palatable than if allowed to stand until the pods are thoroughly mature.

Harvesting.

The amount of forage obtained from Soy bean will of course vary widely according to the conditions under which the crop is grown. Under favourable circumstances as much as 12 or 13 bushels of fresh fodder may be produced per acre, and 25 to 40 bushels of seed. It has been shown under the head of experiments that from 500 to 1,000 lbs. of seed per acre may be obtained in India in a good year.

The different races of the Soy bean are distinguished according to the colour of the seeds and shape and size of the pods. Dr. C. D. Harz, in his "Landwirthschaftliche Samenkunde," Berlin, 1885, adopted a botanical arrangement of the Soy plants so as to include all the then known forms of seeds. Two so-called race-groups and eight races are thus enumerated.

RACES AND  
VARIETIES.

Race-group. *Soja platycarpa*, Harz., flat fruited.

1. *olivacea*, Harz., olive-brown Soy beans, weight of 100=15.04 grammes.
2. *punctata*, Harz., punctated Soy bean.
3. *melanosperma*, Harz., black-seeded, long Soy bean, weight of 100=14.25 grammes.
4. *platysperma*, (*S. compressa nigra*, M.) black, flat Soy bean.
5. *parvula*, Martens, seed as above, but smaller.

Race-group. *Soja tumida*, Harz., swollen fruited bean.

6. *pallida*, Roxb. (*S. sphaerica rivescens*, Mart.) Pale, yellow, yellowish, greenish-yellow bean, weight of 100=11.7 to 25.69 grammes.



PLACES AND  
VARIETIES.

7. *castanea* (*S. elliptica castanea*, M.) brown Soy bean, weight of 100=8.15 to 16.76 grammes.

8. *atrosperma*, Harz. (*S. sphaerica nigra* and *S. sph. minor*, Mart.) Black seeded, weight of 100=16.30 to 21.0 grammes.

For the classification prevalent in Manchuria, the following arrangement is taken from "Manchuria, its people, resources and recent history" by Sir Alexander Hosie (1904):—

- |                         |                                      |
|-------------------------|--------------------------------------|
| Yellow bean (Haung-Tow) | (a) White eyebrow.                   |
|                         | (b) Golden yellow.                   |
|                         | (c) Black belly.                     |
| Green bean (Ching-Tow)  | (a) Epidermis green, inside yellow.  |
|                         | (b) Epidermis and inside both green. |
| Black bean (Wu-Tow)     | (a) Large, inside green.             |
|                         | (b) Small, inside yellow.            |
|                         | (c) Flat, inside yellow.             |

In the Province of Szechuen in Western China the following well-marked varieties of Soy beans are cultivated:—

1. Yellow Soy bean.

- (a) White yellow bean (Pai Huang Tou). This is the lightest coloured of the yellow beans. They are ovoid in shape, not much larger than the common pea and weigh 150 to the ounce (100 seeds=18.88 grammes). As a rule they are cooked whole and served as a vegetable.
- (b) Large yellow bean (Ta Huang Tou).—There is a slight tinge of green in these beans which are larger and heavier than the preceding. 122 weigh one ounce (100 seeds=23.22 grammes).
- (c) Small yellow bean (Hsiao Huang Tou).—This kind has the same ovoid shape but is much smaller than the others. 266 weigh an ounce (100 seeds=10.65 grammes). It is extracted from *a* and *b*, while *c*, which is less expensive, is in demand for making bean-curd.

2. Green Soy bean (Ching Tou).—There are two kinds of this bean, one in which the epidermis and inside are both green and the other in which the inside is yellow. It is of the same size, shape and weight as the white yellow bean (100 seeds=18.88 grammes). Both kinds are cooked and eaten as a vegetable and are also salted and put away in jars for winter use.

The yellow and green varieties of Soy bean occupy the ground from April to August, whereas the black kind takes much longer to mature.

3. Black Soy bean (Hei Tou). Of this there are two kinds—

RACES AND  
VARIETIES.

- (a) The first is much larger, rounder and heavier than the yellow and green varieties. Only eighty-eight weigh one ounce (100 seeds=32.19 grammes). Like the green beans it is used cooked in its fresh state as well as pickled.
- (b) This is a small flattish bean; about 450 going to the ounce (100 seeds=6.29 grammes). It is used principally in medicine, also for food. Both the forms are black outside and yellow inside, the testa of the former being readily detachable when crushed.

#### *Races in India.*

It will be seen from the foregoing that there is a large variety of Soy beans in cultivation in China and Japan. At the Universal Exhibition held at Vienna in 1873 there were 13 varieties exhibited, differing according to shape, size and colour. M. A. Pailieux, author of "*Le Soya, sa composition chimique, ses variétés, sa culture et ses usages,*" (Paris 1881), concludes that there are 30 varieties of the pulse.

RACES IN  
INDIA.

The following are the results of an attempt to classify the different varieties of Soy beans collected together in the office of the Reporter on Economic Products to the Government of India.

First of all the seeds are classified under four heads according to their colour, *viz.*, Yellow, Green, Black, Brown and Mottled. These are again subdivided according to their weights, which have been ascertained by Babu S. C. Mukerji, M.A.

#### *A.—The Yellow Races.*

I. Large Yellow Soy Bean. They are globose seeds, one hundred weighing from 21.40 to 21.64 grammes. They have been grown in the Poona Experimental Farm, most probably from the Chinese seeds known as Te Huang Tou or Large Yellow Bean.

Yellow seeds

II. Pale Yellow Bean. These are globose yellowish seeds but smaller than the preceding (100 seeds=16 grammes on an average). They seem to be Pai Huang Tou (White Yellow Bean) that have been introduced into Poona. One sample comes from Northern Shan States, Burma (100 seeds=17.62 grammes).

III. Small Yellow Soy Bean. They too are globose or ovoid in shape but one hundred of them weigh only about 10 grammes on an average. (The weight varying from 9 to 12 grammes.) They were mostly

RACES IN  
INDIA.  
Yellow seeds.

obtained from the Experimental Farm of Poona and seen to be Hsiao Huang Tou (small yellow bean) of China. One sample comes from Haka, Chin Hills, Burma (100 seeds = 9.49 grammes) and another from Kalimpong, Darjeeling (100 seeds = 9.21 grammes).

IV. Smaller Yellow Soy Bean. These samples are elliptical in shape and 100 seeds weigh on an average about 7 grammes. The seeds have been received from Tiddim, Chin Hills, Burma; Kalimpong, Darjeeling; Kathā, Burma; Chakrātā, Dehra Dūn; and Simla, Punjab.

V. Smallest Yellow Soy Bean. They are elliptical or reniform in shape and very small, 100 seeds weighing from 3.5 to 5.9 grammes. They come mainly from Burma.

#### B.—The Green Races.

Green seeds.

The ovoid green beans are grown in Poona from Chinese seeds but they have become smaller in the plants naturalized in India, one hundred weighing from 11.24 to 15.68 grammes (whereas 100 seeds of the Chinese Green race weigh 18.8 grammes). The epidermis of the seed only is green, the interior being yellow.

#### C.—The Black Races.

Black seeds.

In these races, the epidermis only is black, the inside is yellow.

I. The large globose race, is represented by a sample from Poona, evidently grown from Chinese or Japanese seed. But 100 seeds weigh 21.5 grammes whereas 100 seeds of the Chinese variety weigh 32.19 grammes.

II. The Small Black Soy Bean. This bean with flattish elliptical seeds is comparatively largely grown in various districts of the United Provinces and Patna Division as well as on the lower slopes of the Himalayas from Kashmir to Darjeeling. Their weight indicates the plant to be the same as is known in China as the smaller-seeded of the two races called together Hei Tou (Black Bean); 100 seeds weigh 4 to 6 grammes. This has been cultivated for a long time by the natives of India.

It is observed, moreover, that the races of this small black Soy bean that are grown in hilly places like Kashmir, Simla, and Darjeeling have heavier seeds than those grown in the plains of the United Provinces and Patna. The average weight of 100 seeds of five samples from the hills is found to be 6.5 grammes whereas the average weight of 100 seeds of eleven samples from the plains is 5 grammes only. This illustrates the fact that the plant growth is affected by the situation.

*D.—The Brown Races.*

I. The Large Brown Soy Bean. There is a sample from Kalimpong, Darjeeling, of large globose seeds (100 seeds=24.66 grammes); this is the heaviest of all the samples of Soy beans in the Museum collection.

RACES IN  
INDIA.  
Brown seeds.

II. The Small Brown Soy Bean. They are flattish, elliptical in shape and are grown in the Himālayas from Kashmir to Darjeeling. The weight of 100 seeds varies from 7 to 8.5 grammes; the average weight in five samples is 8 grammes.

*E.—The Mottled Races.*

There only one sample of this yellow and brown race obtained from Shillong. The seeds are elliptical in form and 100 seeds weigh 10.15 grammes.

Mottled seeds

Both the brown and mottled races have their epidermis only so coloured, the interior being yellow. They are not described in the above-quoted reports. They appear to have been cultivated for a long time by the natives of Assam and the lower Himālayas. The colour of the brown seeds is called "khair," from its resemblance to the colour of catechu or catechu.

*Composition.*

In Church's "Food Grains of India" a typical analysis is given of Soy bean presumably cultivated in the country. It contained—

COMPOSI  
TION OF  
THE SEED.

Water	11.0
Albuminoids	35.3
Fat	18.9
Non-nitrogenous extractive	26.0
Fibre	4.3
Ash	4.6

Many analyses have been made of the bean grown under various names and in different countries. Several analyses are quoted in König's "Chemie der menschlichen Nahrungs- und Genussmittel," Vol. I., pp. 595-600 and 1481. An examination of the results shows that the percentage of oil in the absolutely dried seeds from different countries varies as follows :—

Chinese beans	17.60 to 26.18
Japanese	12.35 „ 25.55
Java	18.37 „ 26.18
Grown in Europe	15.16 „ 21.89
Grown in North America	18.42 „ 19.52

## COMPOSITION OF THE SEED.

The average of eight analyses from China is 19.89. The average of six analyses from Japan is 20.01. The average of six analyses from Java is 21.62. The average of forty-two analyses from Europe is 18.98, being from Germany fourteen analyses with an average of 19.74, from Austria eleven, average 19.44, from Hungary six, average 19.16, from Russia nine, average 17.93, from France two, average 15.40.

In examining the Indian-grown seeds there is not much variation from the type except a slight decrease in oil in seeds from Burma and the United Provinces. Soy beans are specially rich in proteids and oil. The oil-content is rather remarkable and at once distinguishes the bean from all other pulses. Edible leguminous seeds give about 2 per cent. of oil, except the Chick pea (*Cicer arietinum*) which gives between 4 and 5 per cent.

Dr. J. W. Leather in 1903 analysed the seeds of seven samples of Soy bean from Japanese seeds cultivated at Manjri, near Poona. The amount of oil in them varied from 14.92 to 23.05 per cent. being on the dry weight 15.97 to 24.41 per cent. with an average of 19.99. In 1902 Dr. Leather examined five samples grown on the Dumraon Farm. They yielded from 14.27 to 19.72 per cent. of oil on the air-dried seeds.

Fourteen samples of the seeds grown from Japanese seeds at the Manjri Experimental Farm were again analysed last year by a leading European firm. The percentage of moisture varied from 9.90 to 12.06, and the percentage of oil from 16.80 to 22.48. Here there is no evidence of deterioration. In the opinion of a crusher to whom the samples were sent, eleven of the fourteen samples were declared to be good and six showing above 20 per cent. of oil, very good indeed and better in this respect than the best Sakura Manchurian beans which contain on an average 19.5 per cent. of oil.

analyses  
made in  
India.

The following analyses of Indian-grown Soy beans were made in the laboratory of the Indian Museum in 1909 and 1910.

*Soy Beans, Burma.*

		Oil.	Oil in dry.	Water.	Ash.
31574	Haka, Chin Hills. Yellow . .	15.20	18.53	18.0	5.3
31614	Mandalay " . .	10.66	15.57	12.3	5.6
31615	Bhamo " . .	16.14	20.45	21.1	6.4
31616	Lower Chindwin " . .	13.03	15.47	15.8	6.1
31619	Northern Shan States " . .	16.72	18.77	11.0	5.1
31620	" " " with brown spots	17.35	19.73	12.1	5.5
31626	Chin Hills, yellow . .	17.35	19.34	10.3	6.1
31705	Northern Shan States, greenish .	20.05	21.78	8.2	6.0

**Soy Bean in India. (David Hooper.)**

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<i>Soy Beans, Burma—continued.</i>					COMPOSITION OF THE SEED.
	Oil.	Oil in dry.	Water.	Ash.	
31706 Northern Shan States, yellowish . . .	14.29	15.55	8.1	5.7	Analyses made in India.
31707 " " " " . . .	16.43	17.88	8.3	5.7	
32043 Lashio, Northern Shan States . . .	13.96	14.93	6.5	5.9	
32074 Katha . . . . .	14.5	15.6	7.0	5.5	
32214 Myitkyin "Lasi N'Loi" . . .	15.63	16.86	7.3	4.9	
32215 " " " " . . .	13.5	14.54	7.2	5.0	
32216 " "Lasi N'Hti" . . .	14.8	15.94	7.2	5.1	
32217 " " " " . . .	13.8	14.85	7.1	5.0	
32265 Bhamo . . . . .	11.15	12.0	6.7	5.6	

*Soy Beans, chiefly from Hill Tracts.*

	Oil.	Oil in dry.	Water.	Ash.
31426 Nagpur, yellowish . . .	16.61	17.89	7.2	4.7
31535 Kalinpong, black . . .	15.50	17.03	9.0	5.5
31560 " white . . .	16.51	17.83	7.4	5.5
31567 " brown . . .	17.25	18.98	9.1	5.6
31568 " green . . .	19.52	20.87	6.5	5.6
31569 " yellowish . . .	16.62	18.34	9.4	5.6
31577 Patna, black . . .	14.72	17.05	13.7	5.7
31617 Shillong, white and brown . . .	15.66	17.63	11.2	5.4
31701 Kangra . . . . .	14.25	15.47	7.9	5.9
31702 Simla, brown . . .	16.83	18.29	8.0	5.1
31703 " yellowish . . .	18.09	19.57	7.6	5.5
31704 " black . . . . .	17.14	18.55	7.6	5.8
31803 Naga Hills, whitish . . .	14.83	16.75	11.4	5.5
32027 Kashmir . . . . .	16.59	17.76	8.6	4.5
32028 " brown . . . . .	14.77	15.84	6.8	4.8
32583 Trivandrum, white . . .	16.16	18.38	12.1	5.8
32870 Darjeeling, green . . .	17.45	19.80	11.9	5.7
32871 " white . . . . .	16.05	18.18	11.2	5.0
32872 " yellow . . . . .	17.60	19.55	10.0	5.8
32873 " brown . . . . .	16.85	19.09	11.7	5.6
32874 " black . . . . .	15.25	17.29	11.2	5.5
Average . . . . .	16.36	18.27	9.3	5.4

*United Provinces, black seeds.*

	Oil.	Oil in dry.	Water.	Ash.
Farrakhabad (3 samples) . . .	15.67	16.7	6.8	4.9
Kheri (3 " ) . . . . .	14.95	16.0	6.5	4.4
Sitapur (3 " ) . . . . .	15.80	16.8	7.0	4.5
Unao (3 " ) . . . . .	15.81	17.0	7.5	4.6
Fatehgarh (2 " ) . . . . .	15.03	16.1	6.7	4.6

COMPOSITION OF  
THE SEED.

## United Provinces, black seeds—continued.

Analyses made in India.			Oil.	Oil in dry.	Water.	Ash.
	Mainpuri (5 samples)	. . .	16.52	17.8	7.2	4.9
	Hardoi (6 " )	. . .	16.44	17.7	7.5	4.7
	Etawah (6 " )	. . .	16.60	18.0	7.6	4.8
	Chakrata (2 " )	. . .	16.75	18.0	7.1	5.6
	Shikohabad (2 " )	. . .	17.10	18.3	6.7	4.8
	Lakhimpur (2 " )	. . .	16.22	17.5	7.1	5.2
	Average	. . .	16.06	17.2	7.0	4.8

## Soy Beans, Poona.

			Oil.	Oil in dry.	Water.	Ash.
31776	Yellowish	. . . . .	20.55	22.07	6.9	6.8
31777	"	. . . . .	19.50	20.86	6.5	6.2
31778	"	. . . . .	19.75	21.19	6.8	7.1
31779	"	. . . . .	20.0	21.67	7.7	7.0
31780	"	. . . . .	20.35	21.68	6.6	6.0
31781	Greenish	. . . . .	19.10	20.51	6.9	6.3
31782	"	. . . . .	17.30	18.72	7.6	6.1
31783	Yellowish	. . . . .	21.20	23.84	7.2	6.6
31784	"	. . . . .	18.25	19.79	7.8	6.1
31785	Black	. . . . .	19.10	20.73	7.9	6.1
31786	Yellowish	. . . . .	22.05	23.84	7.6	6.3
31787	Mixed	. . . . .	22.4	24.21	7.6	6.3
31788	"	. . . . .	19.30	21.00	8.1	5.4
31789	Yellowish	. . . . .	19.80	21.67	8.2	6.2
31790	Green	. . . . .	21.70	23.56	7.9	5.9
	Average	. . . . .	20.01	21.61	7.4	6.2

Analyses  
made in  
India.

## The oil.

Soy bean oil is largely used as food in the Far East. The oil has many other uses. Thus, in China, it is used for illuminating purposes and as it is a drying oil, it can be used in the manufacture of paints in the place of linseed oil. In Europe as well as in Eastern Asia it is employed in the manufacture of soap and as a machine lubricant.

The oil expressed from Soy beans is a favourite article of diet in Eastern Asia. Recently it has been used in the manufacture of margarine or artificial butter. The digestibility of the oil for man was studied by Korentschewski and Zimmermann in 1906. The coefficient of digestibility was found to be about 95 per cent. Thus it is seen that Soy bean oil is thoroughly assimilated.

An attempt in 1903 to extract oil from these beans with the country *oil-ghani* or indigenous oil-mill in the usual way was a failure in Bombay. The oil is expressed by means of primitive plant in the Chinese factories. The method of extraction consists in first crushing the beans into caked masses by means of mill-stones, then heating them on stone slabs until the appearance of vapours, and finally expressing them in an iron receptacle. As first obtained the oil is turbid but after some time becomes clear, the deposits consisting of sand particles and vegetable fibres. Only the clear oil is exported, but the turbid oil is sold locally. It has a faint odour recalling that of Chinese wood (tung) oil, is bland to the taste and of a dark-brown colour.

Four commercial samples examined in 1905 by W. Korentschewski and A. Zimmermann gave the following results:—Water, 0.3 to 1.50 per cent.; specific gravity at 15°C., 0.9264 to 0.9287; solidification point, 14.6° to 15.3°C.; saponification value, 207.9 to 212.6; ester value, 203.9 to 207.7; insoluble fatty acids, 93.6 to 94.28 per cent.; iodine value (Hübl) 114.8 to 137.2; solidification point of fatty acids, 16° to 77.3°C.; m. pt. of fatty acids, 20° to 21°C.; Maumené test 102° to 116°C.; and acid value, 1.86 to 15.46.

It belongs to the class of semi-drying oils, that is to say, it has properties intermediate between those of the drying oils, such as linseed oil and the non-drying oils such as almond and olive oils. On exposure to the air, a thin skin is gradually formed on the surface. It resembles cotton-seed oil in many respects, but is of a more pronounced drying character, as is indicated by its higher iodine value (the iodine value of the cotton-seed oil being 101 to 116). The oil consists mainly of the glycerides of palmitic, oleic and linolic acids.

#### *Oil-cake.*

The Soy bean oil-cake left after the oil is expressed is a valuable **OIL-CAKE** cattle food, and may be substituted for the dearer decorticated cotton cake. Some cases of supposed poisonous action of the cake have been reported in England. The cause was probably due to overfeeding or admixture with noxious ingredients. Soy-bean cake being exceedingly rich and concentrated, should be used with discretion especially in the case of dairy cows. It is also used as a manure. The following analysis of the cake is taken from the *Agricultural Gazette of New South Wales*, Vol. XX., 1909, p. 671:—

"Moisture—14.52; ash, 5.16; fibre, 4.03; albuminoids, 42.31; carbohydrates, 25.25; other extract (fat and oil), 8.73; nutritive value, 87.3; albuminoid ratio, 1 to 1.06.



"The ash is rich in potash salts and phosphates and the manurial value is shown by the proportions of fertilising ingredients which are, as follows, in the whole cake:—nitrogen, 6·77 per cent. ; potash, 2·00 per cent. ; phosphoric acid, 1·33 per cent."

Soy-bean cake exported from Manchuria is stamped with the manufacturer's brand, and contains a guaranteed analysis of 6·5 per cent. of total nitrogen and 1·5 per cent. of phosphoric anhydride.

#### *Composition of Hay.*

The Soy bean is cultivated in the United States of America mainly as a forage crop and numerous experiments have been made in its growth. The following table showing the composition of the various kinds of forage made from the Soy bean (in a fresh or air dried condition) is taken from the U. S. Farmers' Bulletin, No. 58 :—

Soy bean forages.	Water.	Protein.	Fat.	Nitrogen free extract.	Fibre.	Ash.
Fodder (early bloom to early seeds) . . . . .	78·5	3·8	1·0	10·1	6·5	2·3
Soy bean hay (Mass) . . . . .	12·1	14·2	4·1	41·2	21·1	7·3
" " straw ( " ) . . . . .	11·4	4·9	1·9	37·8	37·6	6·4

Dr. Leather obtained the following figures as the average of five analyses of "bhusa" or dried green tops of Soy grown at Dumraon in 1902 :—water, 9·85; fat, 1·0; protein, 3·7; nitrogen free extract, 46·07; fibre, 28·44; ash, 10·94 per cent.

When dealing with the chemical analysis of the Soy-bean forage, it should be noted that the proper value of a forage does not depend on its composition only, but the digestibility of the various components must be taken into account. Quoting again from the Farmers' Bulletin, "The following rough computation will give an idea of the amount of digestible matter in the forage raised on an acre planted with this crop. Under ordinary farm conditions the yield of green fodder usually ranges from 6 to 12 tons per acre. Taking 8 tons as an average yield, the amount of dry matter will be about 2 tons, of which about 54 per cent. is digestible. This will make the digestible matter raised on an acre of ground amount to nearly  $1\frac{1}{4}$  ton. Of this amount about one-sixth is protein or muscle-making material and about three-fourths crude fibre and other fat-forming substances."

#### *Use as food.*

The Soy bean is very largely eaten by the Chinese and Japanese as a vegetable, and many food preparations are made from it. It is a very

important article of diet for people whose staple food is rice, a cereal very AS FOOD, poor in proteid or nitrogenous substances. The highly nitrogenous Soy bean supplies the place of meat in European countries, and the introduction of this rich bean into the dietary of the rice-eating people of India would be a benefit to the country.

Three Japanese food preparations are specially made from the bean : Soy-bean milk, Soy-bean cheese or "topo," and Soy-bean sauce or "Shoyu."

**Soy-bean milk.**—The Soy beans are first soaked in water for about twelve hours and then well crushed between mill-stones. The powder is then boiled with about three times its bulk of water for about an hour and filtered through cloth. The filtrate resembles cow's milk in appearance and to some extent in composition ; it is easily digestible and forms a highly nitrogenous liquid, but it is not suitable for the nourishment of children.

**Bean cheese.**—When Soy-bean milk is treated with magnesium chloride (or the mother liquor obtained in the manufacture of common salt from sea water) the proteids are separated in the form of a precipitate. This is collected on a filter, pressed and dried, and forms "topo" or Soy-bean cheese. It is eaten in a fresh state.

**Shoyu.**—Shoyu is a sauce prepared from a mixture of cooked and pulverised Soy beans, washed and powdered wheat, wheat flour, salt and water. The mass is fermented with rice-wine ferment in casks for from one-and-a-half to five years, being frequently stirred. The resulting product is a moderately thick, brown liquid. In odour and taste it is not unlike a good quality of meat extract though perhaps somewhat more pungent. Under the name of "Soy sauce" and other fanciful names it has formed the basis of most of the important sauces of Europe for many years.

Roasted Soy beans are being used in the United States and Switzerland as a coffee substitute.

The Soy bean contains little or no starch and is consequently used as a diet for diabetic patients. Bread and biscuits made from Soy-bean flour are now being placed on the European markets.

#### *Trade.*

Soy bean used to be cultivated in Manchuria to meet the demands TRADE, in China and Japan, but from the year 1903, Europe has entered the field as a chief customer. During the last few years the Manchurian trade in Soy beans has prospered by leaps and bounds. The chief cause of this sudden development is certainly the last Russo-Japanese war

when agriculture in Manchuria was greatly stimulated as this country had to provide for the large number of soldiers located there. At the end of the war the armies were withdrawn, and Manchuria was obliged to export the surplus of its food products mainly, Soy beans.

The first large cargo of the bean reached Hull on the 2nd of March 1909, and contained 5,200 tons. Ever since then the demand for this bean has rapidly increased and British oil-crushers are setting up big machines for the bean-oil. On the continent of Europe as well as in England, a good deal of interest is being manifested in the Soy bean industry. The following facts taken from the "Indian Trade Journal," April 28th, 1910, will give an idea of the importance that this trade is rapidly acquiring nowadays.

"Up to 1907 the total exports of Soy beans from Manchuria did not exceed 120,000 tons annually. In 1908 the shipments amounted to 330,000 tons and in 1909 they ranged between 700,000 and 800,000 tons.

It is understood that large elevators are being erected outside Hull for handling the bean. This indicates that the trade is expected to be not only large but permanent; and there remains no doubt that this remarkable new trade will affect the Indian business in oil seeds."

Mr. F. E. Wilkinson, H. M. Consul at Newchwang, in his report on the trade of that district in 1909, writes:—

"In 1908, 178,000 tons of beans and 318,000 tons of bean-cake were exported from Newchwang and 438,000 tons of beans and 276,000 tons of bean-cake from Dairen, making a total of 616,000 tons of beans and 594,000 tons of bean-cake. Now as 100 tons of beans are required to produce 9 tons of oil, it may be estimated that to produce 594,000 tons of bean-cake, 653,400 tons of beans must have been treated so that the total quantity of beans represented by the combined exports of bean produce from the two ports was 1,269,400 tons. Exports from other places on the coast would bring the total exports from South Manchuria to about 1,300,000 tons".

Mr. R. M. Hodson, H. M. Vice-Consul at Vladivostok, in his report on the trade of that district in 1908 to 1909, writes:—

"The Soy bean export to Europe through Vladivostok commenced in December 1908 and shipments continued all through 1909 till October, the total amount exported to Europe being 200,000 tons. The cargo was nearly all carried in British bottoms and destined to oil mills in the United Kingdom.....The centre of the trade for North Manchuria is Kharbin and several British firms have recently opened buying agencies there."

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One great advantage in Soy bean trade is that the beans arrive in **TRADE.** Europe in a perfect condition from distant Manchuria.

*Price.*

The following extract is from the report of the Consul at Newchwang from which an extract has already been made :—

“At the time of the first shipments to Europe, the price of the beans laid down at Dairen was about £3 10s. per ton. By the spring of 1909 the value of the Soy bean as an article of commerce had become generally known, and a large number of British and other firms entering the field as prospective buyers, competitions gradually drove the price up. The new crop though well up to the average, proved not to be equal either in quality or quantity to that of 1908. The price of beans consequently rose still further and in February 1910, it reached 46 5s. per ton, the highest point it has touched as yet.

“At the price mentioned, China and Japan are practically out of the market as buyers and about 80 per cent. of the purchases of beans made since December last have been for the European market.”

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